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APPENDIX G

SPECIFIC WEIGHT OF DEPOSITS

G-1. Specific Weight of Deposits. The three steps in calculating the specific weight of a sediment deposit are:

a. determine the initial specific weight of each type of material (i.e., sand, silt, and clay),

b. calculate the compaction over time,

c. calculate the composite specific weight of the mixture of materials in the deposit.

G-2. Initial Specific Weight.

a. Lane and Koelzer correlated the specific weight of sand, silt and clay with reservoir operation. They expressed the results as a table of coefficients in the form of Table G-1.

b. Lara and Pemberton [33] updated that work based on the analysis of 1300 samples. While retaining the basic concept of Lane and Koelzer, they modified their coefficients. Table G-1 shows that result.

c. There is sufficient variability in deposits to require field measurements at each site, but the values in Table G-1 are satisfactory for planning purposes. The initial weights are shown in columns Ws, Wsl, and Wcl.

TABLE G-1. Constants for Estimating Specific Weight of Reservoir Sediment Deposits

Type	Reservoir Operation	Sand*		Silt*		Clay*	
		Ws	Ks	Wsl	Ksl	Wcl	Kcl
1	Sediment always submerged	97	0	70	5.7	26	16
2	Normally moderate to considerable reservoir drawdown	97	0	71	1.8	35	8.4
3	Reservoir normally empty	97	0	72	0	40	0
4	River bed sediments	97	0	73	0	60	0

* The American Geophisicial Union size classification scale. See Particle-size classification in the glossary.

G-3. Consolidation of Deposits with Time.

a. Two cases are important for consolidation: (1) the consolidated specific weight at the end of a specified time; and (2) the average consolidated specific weight during that period.

b. The equation for case 1, the instantaneous case, is shown first.

$$W = Wi + C * \log(T) \qquad \text{(G-1)}$$

where

C = Consolidation coefficient
T = age of deposit in years
Wi = initial specific weight of deposited material
W = specific weight at time T.

c. Columns Ks, Ksl, and Kcl are consolidation coefficients for C in that equation.

d. Miller [41] integrated the equation to satisfy the second case as follows:

$$W(T) = Wi + C * [\ (T/T-1) * \log(T) - 0.4343\ ] \qquad \text{(G-2)}$$

where

W(T) = average unit-weight over T years of operation
C = the consolidation coefficient from Table G-1

G-4. Composite Specific Weight of a Mixture. The composite specific weight of a mixture of deposited sediments [14] is estimated by:

$$Wc = 1. / [\ (Ps / Ws) + (Psl / Wsl) + (Pcl / Wcl)\ ] \qquad \text{(G-3)}$$

where

Ps = percent sand in mixture expressed as decimal
Psl = similar quantity for silt
Pcl = similar quantity for clay
Wc = composite specific weight of mixture

G-5. Example 1. Determine the composite, initial specific weight for the following deposit.

a. Reservoir Operation = Type 2

b. Inflowing sediment size analysis: 25 percent clay, 40 percent silt, 35 percent sand.

$$\begin{aligned} Wc &= 1/[(.25 / 35) + (.40 / 71) + (.35 / 97)] \\ &= 1/(.0071 + .0056 + .0036) \\ &= 61.0 \text{ lb/ cu ft} \end{aligned}$$

G-6. Example 2. Calculate the composite specific weight of the deposit after 50 years of operation using data given in Example 1.

a. Calculate the average specific weight for each class of material using Miller's equation.

sand: $Ws(50) = 97$

silt: $Wsl(50) = 71 + 1.8 *[(50/49) * \log(50) - .4343]$
$= 73$

clay: $Wcl(50) = 35 + 8.4 *[(50/49) * \log(50) - .4343]$
$= 46$

b. Calculate the composite specific weight of the mixture using Colby's method.

$$WC = 1/ [(.25 / 46) + (.40 / 73) + (.35 / 97)]$$
$$= 68.86 \text{ \#/cu ft}$$
use 69

G-7. Measurement of Specific Weight of Deposits.

a. In-situ measurement with instruments such as a gamma probe is the most desirable method of determining specific weight of deposits. Proper procedures should be followed to insure the probe is calibrated and the sample are representative of the total deposits.

b. The average specific weight can be calculated by multiplying the specific weight of each sample by the volume it represents, summing the values, and dividing the results by the total volume.